Summary of ICCR Source Work Group Meeting
Long Beach, California
July 30, 1998
Stationary Combustion Turbine Work Group

I. Purpose

The main objectives of the meeting were as follows:

- Discuss CTWG goals through September in light of EPA's non-renewal decision and identify steps needed to achieve goals
- Discuss progress of CTWG task groups and what should be passed onto the CC

II. Location and Date

The meeting was organized by the U.S. Environmental Protection Agency (EPA) and was held at the Renaissance Long Beach Hotel, Long Beach, California. The meeting took place on July 30, 1998.

III. Attendees

Meeting attendees included representatives of the EPA, trade associations, industry, turbine manufacturers, and state agencies. A complete list of attendees, with their affiliations, is included as Attachment I.

IV. Summary of Meeting

The meeting consisted of discussions and presentations between WG members and public participants on selected issues which are listed below. The meeting agenda is provided as Attachment II. A bullet point summary of the meeting is presented as Attachment III.

The topics of discussion included the following:

- Discussion of EPA's FACA Non-Renewal Decision
- Review of Status of Active Task Groups to Identify What Work to Complete and Forward to the CC by September
    - Testing Task Group
    - Model Plant Task Group
    - Gas Combustion Task Group
    - Pollution Prevention Task Group
- Review of Status of Less Active Task Groups to Identify any Work to Complete and Forward to the CC by September
    - Database Task Group
    - HAP Reduction Technology Task Group
    - HAP vs. Criteria Pollutant Task Group
    - MACT Floor Task Group
    - Planning Task Group

- Subcategorization Task Group
- Discussion of Information Collected on Cost-Effectiveness
- Next meeting

Discussion of EPA's FACA Non-Renewal Decision

- Sims Roy reviewed EPA's decision to not renew the FACA charter with the WG. He indicated that the charter will be extended until September 20, 1998, and that the CC would meet for the final time in September. The structure and timing of individual source work groups' meetings at the September meeting may differ from the past; the WGs may meet the day before the CC meeting or not at all, depending on the needs of each source WG. He reviewed EPA's responses to questions concerning the decision that came up at the co-chairs and CC meetings.
- WG members inquired about the possibility of the CTWG remaining a group that could meet with EPA on a regular basis to keep up to date with the rulemaking. Sims Roy indicated that since the CTWG was established by EPA, the group could not continue providing advice to EPA under the guidelines of FACA.
- Valerie Overton reviewed the CC's request for three types of work items for the September CC meeting: closure items, works in progress (ongoing and new), and data/information items. Ted Guth presented the tentative list of CTWG items presented at the CC meeting. This presentation is attached as Attachment IV. The final list of items in each category is to be posted to the ICCR TTN by August 31, 1998, with items unlikely to be available electronically footnoted. Electronic versions of the items to be considered by the CC are to be posted to the TTN by September 4, 1998.
- Several WG members wished to provide feedback to EPA on the FACA non-renewal decision.
  - Marvin Schorr indicated that many companies have advocated getting involved in the regulatory process for a long time and regarded this process as an opportunity for involvement. He expressed disappointment that, with this effort, there has been no reciprocity on the part of EPA to commitments they expect from others. He indicated that GE made a four year commitment going into this effort and thought that EPA had done so as well. He felt the decision was poorly handled by EPA and indicated that some people were not even aware that the charter had to be renewed every two years. He expressed disappointment in EPA's decision and was bothered that the decision was made without outside consulting.
  - Ted Guth indicated that he agreed with Marvin, but mentioned that EPA did consult with WG members via facilitators. He said that, according to EPA, the consensus among WG members was that they wanted to keep the process going. Therefore, EPA must have made the decision based on other factors and information.
  - Greg Adams expressed the opinion that the CTWG has been a well-focused group and that he is bothered that the

benefit of the group's expertise will not be available to the EPA during development of the final regulation. He was disappointed that the process will no longer be as open.

- A.J. Cherian said that he is also disappointed that the partnership didn't work, but acknowledged that EPA was pushed into a corner as far as the schedule goes and that industry representatives should share part of the blame.
- Gordon Brown indicated that he was very surprised with the decision. He felt like it was an abrupt decision and expected, at the very least, that the charter would be extended for about six months. He felt that the decision was inconsistent with the feedback that EPA received and asked at what level of EPA the decision was made.
- Sims Roy explained that the decision was made at the upper management level by John Seitz of OAQPS. He also explained that everybody seemed to agree that the process needed to be drastically changed; WG members responded that 15-20% of their time was being spent on ICCR and that most of this time was spent attending meetings, downloading and reading documents from the TTN, while only 3-4% of the time was spent on doing actual work. He indicated that consensus opinions were rarely reached, and that EPA realized that more contentious issues are forthcoming. He said that Bruce Jordan looked at the deadline for the final regulation and felt like EPA was on the edge of not even meeting a deadline of 18 months past the required date for MACT standards.

Status of Testing and Monitoring Task Group

- Sims Roy reviewed the testing priorities decided upon as a result of the co-chairs recommendations. Since resources may be limited, resources will first be focused on incinerators (section 129), boilers, and engines. Criteria for testing should be based on which sources emit the greatest quantity of toxic pollutants and on the amount of data that will be needed to write the final MACT rule.
- Sims Roy indicated that funds for turbine testing may be available in the FY 1999 budget but that availability of funds is unknown at this time. Environmental groups have mentioned turbines in terms of children's health and are concerned about formaldehyde and PAHs (as benzo(a)pyrene).
- The WG decided to push to get a summary report of the CO catalyst test conducted by API/GRI to the CC at the September meeting. Gordon Brown and Sims Roy will keep in contact with GRI on this issue.
- The WG discussed what testing priorities should be now that it is known that limited or no testing may be done in light of limited resources. WG members discussed the usefulness of retesting turbines with questionnable data rather than getting one or two data points for a potential control technology. Many members expressed concern about the SCONOx test report and suggested retesting the unit using full EPA protocols. Other

suggestions for high testing priorities included retesting of the unit with the high formaldehyde data point and generating additional chromium (VI) data.

- Two task groups were formed to address testing issues. The first, led by Derek Furstenwerth, will rethink testing issues and priorities based on the availability of funds and additional review of the high formaldehyde emission point (SCE Coolwater test). Group members are Wilfred Hung, Chuck Solt, Ted Guth, Sims Roy, Marvin Schorr, and Mervyn Soares. The second group will be led by John Klein and includes Jeff Willis, Derek Furstenwerth, Gordon Brown, Ted Guth, and Sims Roy. The task of this group is to review the full SCONOx report and provide their conclusions to the WG.
- The WG discussed a hold harmless agreement (memorandum of understanding)for facilities that would be tested and decided that this issue should be left to EPA at this point since it would need to be determined on a case by case basis.

Status of Model Plants Task Group

- Dan Herndon and Keri Leach gave a presentation on a procedure for estimating national costs and emission reduction impacts. This presentation is included as Attachment V.
- WG members will collect the information needed to complete the model plants analyses. The following issues will be addressed by specific individuals: ductwork costs (Sam Allen and Marvin Schorr); power output reduction due to the increase in pressure drop caused by the catalyst (Chuck Solt); cost differential related to “dirty” fuels (Greg Adams); retrofit costs (Sam Allen and Ted Guth); information from the inventory database that may be useful for identifying those turbines equipped with heat recovery steam generator (HRSG) units (Chuck Solt).

Status of Gas Combustion Task Group

- Marvin Schorr will send a final draft of the Gas Combustion White Paper to task group members on or before August 17, 1998. Members will review and revise the document, as appropriate, to submit as a closure item to the CC at the September meeting.

Status of Pollution Prevention Task Group

- The WG discussed the documents produced by the Pollution Prevention Subgroup of the CC. Chuck Solt will condense the recommendations to those that are potentially applicable to combustion turbines and distribute them to the full WG.
- The WG discussed whether there was anything to pass onto the CC concerning pollution prevention. Gordon Brown, A.J. Cherian, John Klein, and Chuck Solt agreed to update the white paper on turbine efficiency and pollution prevention to reflect the latest P2 issues.

Status of Less Active Task Groups

- The WG discussed the status of the less active task groups to determine if there are any work products that should be forwarded to the CC for consideration.
- Database Task Group: The refined population and emissions databases will be submitted electronically to the CC as data/information items.
- HAP Reduction Technology Task Group: The group decided to transmit hard copies of the reports from the HAP Technology Workshop to the CC at the September meeting. John Klein will develop a cover letter to accompany these documents.
- Subcategorization Task Group: The subcategorization report will be transmitted as is to the CC to be forwarded to EPA. No further action is needed on the part of the Subcategorization Task Group.
- HAP vs. Criteria Pollutants Task Group: Greg Adams will review the summary report and distribute it to the WG for comments prior to submittal to the CC for the September meeting.
- Nothing further is needed from the MACT Floor and Planning Task Groups.

Discussion of Cost Effectiveness

- Sims Roy indicated that he looked at cost effectiveness in other MACT standards and found that it depends on the toxicity of the pollutant being considered. For instance, he reported that he found cost effectiveness (C/E) figures in the $20-$40 million per ton range for one mercury rule and in the low millions of dollars per ton range for chromium VI. He indicated that there are no clear rules for determining what is considered to be cost effective.
- Jim McCarthy presented cost effectiveness values calculated by GRI for oxidation catalysts on turbines. This presentation is included as Attachment VI. He indicated that WG members could request a copy of the full cost report, available August 15, 1998 (GRI-98/0218).
- The group decided to put together a white paper that details C/E factors for turbines to forward to the CC as a closure item. A.J. Cherian will lead this effort; Sam Clowney, Chuck Solt, Gordon Brown, and Sims Roy will assist.

Next Meeting

- The WG decided to hold a face-to-face meeting in lieu of the scheduled August teleconference. The meeting is scheduled for August 26 and 27 in Chicago, Illinois, at GRI's offices.
- The agenda items will include all work items that need to be completed or reviewed to pass to the CC at the September meeting.

The meeting adjourned at 4:30 pm.

These minutes represent an accurate description of matters discussed and conclusions reached and include a copy of all reports received, issued, or approved at the July 30, 1998 meeting of the Stationary Combustion Turbine Work Group.

Sims Roy

ATTACHMENT I

LIST OF ATTENDEES

Stationary Combustion Turbine Work Group Meeting
July 30, 1998
List of Attendees

Sims Roy	EPA OAQPS Emissions Standards Division
Greg Adams	Los Angeles County Sanitation District
Sam Allen	Dow Chemical Company
Gordon Brown	Exxon Chemical Company
Derek Furstenwerth	Houston Lighting and Power Company
Ted Guth	Permitting Regulatory Affairs Consultant
Peter Hill	US Naval Facilities Engineering Svc. Center
John Klein	ARCO Alaska, Inc.
Diane McConkey	EPA OGC
Jerry Napierala	Solar Turbines
Wilfred Hung	Solar Turbines
Jeff Willis	Rolls Royce
Dan Herndon	Alpha-Gamma Technologies
Keri Leach	Alpha-Gamma Technologies
Chuck Solt	Catalytica
Mervyn Soares	Texaco
Marc Phillips	INGAA
Valerie Overton	Eastern Research Group
A.J. Cherian	PG&E Gas Transmission - Northwest
Marvin Schorr	GE Industrial and Power Systems
Jim McCarthy	Gas Research Institute
Stan Coerr	Coerr Environmental
Linda Coerr	Coerr Environmental
Glenn Acosta	Los Angeles County Sanitation District
Terry Harrison	EPA

Arnold Medberry	EPA
Sam Clowney	Tenneco Energy
Craig Harrison	Hunton & Williams/UARG
Lowell Smith	UARG
Ralph Roberson	UARG

ATTACHMENT II

MEETING AGENDA

Tentative Agenda
Stationary Combustion Turbine Work Group
July 30, 1998 Work Group Meeting
Long Beach, California

Objectives

1. *Discuss Turbine WG goals through September in light of EPA's non-renewal decision and identify steps needed to achieve goals*
2. *Discuss progress of Turbine WG task groups and what should be passed onto the CC*

Note *WG members are invited to a turbine site visit in the morning, leaving the hotel at about 7:00 AM and returning in time to convene the WG meeting at 10:00 AM.*

10:00 Open WG Meeting and Review Meeting Agenda/Objectives (S. Roy, V. Overton)

10:15 Review Coordinating Committee Discussion of EPA's FACA Non-Renewal Decision (S. Roy, T. Guth, V. Overton)

— Summarize EPA decision
— Discuss implications for Turbines WG
— Identify goals for Turbines WG between now and September

11:00 Review Status of Active Task Groups to Identify What Work to Complete and Forward to the CC by September (S. Roy, T. Guth, TG leaders)

— Testing Task Group
***Cochairs testing presentation at CC/implications for Turbines WG
***Status of Turbines WG testing effort
***Steps needed to wrap up for September CC meeting

— Model Plant Task Group
***Current status of Model Plants document
***Status of compilation of cost information
***Steps needed to wrap up for September CC meeting

— Gas Exclusion Task Group
***Status of paper/presentation for CC

***Decide what to pass onto CC in September
***Steps needed to wrap up for September CC meeting

— Pollution Prevention Task Group
***P2 Subgroup discussion at CC/implications for Turbines WG
***Status of Turbines WG P2 work
***Steps needed to wrap up for September CC meeting

12:00 LUNCH

1:15 *Review Status of Active Task Groups continued*

2:30 Review Status of Less Active Task Groups to Identify any Work to Complete and Forward to the CC by September (S. Roy, T. Guth, TG leaders)
— Database Task Group
— HAP Reduction Technology Task Group
— HAP vs. Criteria Pollutant Task Group
— MACT Floor Task Group
— Planning Task Group

3:15 Discuss Information Collected on Cost-Effectiveness of Emissions Reductions for Previous MACT Rules (S. Roy)
— Summarize available information
— Discuss implications for this rule and identify next steps

3:30 Discuss agenda for August WG Teleconference (S. Roy, V. Overton)

3:45 Closing Business (S. Roy, V. Overton)
— Review flash minutes (K. Leach)
— Discuss whether meeting objectives were met (WG members)

4:00 ADJOURN

ATTACHMENT III

BULLET POINT SUMMARY

Summary of ICCR Source Work Group Meeting
Combustion Turbines Work Group Meeting
Renaissance Hotel, Long Beach, CA
July 30, 1998

Decisions/Discussion

- The CTWG discussed the status of each of the active and less active task groups and identified work items to submit to the CC at the September meeting. The group decided to submit the following items, in addition to the draft list already submitted to the CC: summary report of the turbine/CO catalyst test conducted by API/GRI, documents from the HAP Reduction Technology Workshop, and a white paper on cost effectiveness.

- The CTWG agreed that no additional actions are required from the Planning and MACT Floor Task Groups.

- The CTWG agreed to meet in Chicago, Illinois, on August 25, 1998.

Next Meeting

- The next Combustion Turbine Work Group Meeting will be a face-to-face meeting on Tuesday, August 25, 1998. The meeting is tentatively scheduled to be held at GRI's offices, pending conference room availability.

Action Items

- Gordon Brown and Sims Roy will keep in contact with GRI to get a copy of the test report summary for the turbine tested with a CO catalyst. This summary report will be submitted to the CC for consideration at the September meeting.

- Derek Furstenwerth, Wilfred Hung, Chuck Solt, Ted Guth, Sims Roy, Marvin Schorr, and Mervyn Soares will rethink testing issues and prioritization based on the availability of funds and additional review of the high formaldehyde emission point (SCE Coolwater test). Derek Furstenwerth will lead the group.

- John Klein, Jeff Willis, Derek Furstenwerth, Gordon Brown, Ted Guth, and Sims Roy will review the full SCONOx report and provide their conclusions to the WG. John Klein will lead this effort.

- Alpha-Gamma will provide full copies of the SCE Coolwater reports and the SCONOx report to the WG members who will be reviewing these documents.

- The Model Plants Task Group will collect the information needed to complete the model plants analyses. The following issues will be addressed by specific individuals: ductwork costs (Sam Allen and Marvin Schorr); power output reduction due to the increase in pressure drop caused by the catalyst (Chuck Solt); cost differential related to "dirty" fuels (Greg Adams); retrofit costs (Sam Allen and Ted Guth); information from the inventory database that may be useful for identifying those turbines equipped with heat recovery steam generator (HRSG) units (Chuck Solt).

- Marvin Schorr will send a final draft of the Gas Combustion White Paper to task group

members on or before August 17, 1998. Members will review and revise the document, as appropriate, to submit as a closure item to the CC at the September meeting.

- Gordon Brown, AJ Cherian, John Klein, and Chuck Solt will update the white paper on turbine efficiency and pollution prevention (P2) to reflect the latest P2 issues.

- Chuck Solt will condense the P2 recommendations into those that are potentially applicable to combustion turbines and distribute to the full WG.

- John Klein will develop a cover letter to accompany the HAP Technology Workshop documents to be submitted to the CC at the September meeting.

- Greg Adams will re-review the HAP vs. Criteria Pollutants Task Group's summary report and distribute it to the WG in time for review prior to submittal to the CC at the September meeting.

- Sam Clowney, AJ Cherian, Chuck Solt, Gordon Brown, and Sims Roy will prepare a white paper on cost effectiveness for submittal to the CC as a closure item, if possible, at the September meeting. AJ Cherian will lead this group.

ATTACHMENT IV

TENTATIVE LIST OF ITEMS TO BE SUBMITTED TO THE COORDINATING COMMITTEE AT THE SEPTEMBER MEETING

Combustion Turbine Work Group

The following items will be brought before the CC at the Sept. meeting:

Draft Closure Items:

- Gas Combustion White Paper
  - A recommendation for EPA to consider a MACT standard of no additional control for gas-fired turbines (and other sources) based on a "preponderance of evidence"

Ongoing Works In Progress:

- Model Turbines and Control Alternatives Cost Analyses for Existing and New Sources
  - Includes control cost analysis and emission reduction estimates for model turbines
- Subcategorization Report
  - Summary of subcategorization discussions and conclusions within the CTWG

Combustion Turbine Work Group

Ongoing Works In Progress, con't.:

- HAPs vs. Criteria Pollutants Report
  - Summary of CTWG discussions on HAPs vs. criteria pollutants tradeoffs
- Turbine Efficiency Improvements and Other P2 Options
  - Summary of CTWG consideration of P2 options

Data/Information:

- Refined Inventory Database
  - Includes version of database that has been reviewed for accuracy and made more usable for CTWG analyses
- Emissions Database
  - Includes latest version of database with all complete source test reports that have passed CTWG QA/QC procedures

ATTACHMENT V

MODEL TURBINES PRESENTATION BY ALPHA-GAMMA

COMBUSTION TURBINES MODEL TURBINE DEVELOPMENT

Procedure for Developing National Costs and Emission Reduction Impacts

Presented to:
Combustion Turbine Work Group
Long Beach, CA

Presented by:
Dan Herndon and Keri Leach
Alpha-Gamma Technologies, Inc.

July 30, 1998

Methodology to Develop National Costs and Emission Reduction Impacts

- Develop model turbines
- Estimate control costs for each model turbine
- Estimate emission reductions for each model turbine
- Relate the model turbines to the turbines in the population database using distribution information
- Estimate economic impacts (EAWG)

ESTIMATE CONTROL COSTS

- Use OAQPS cost factors to estimate total capital investment and annual operating costs and other documented information provided by CTWG
- Catalyst Costs and Lifetime:
  - Englehard vs GE catalyst cost information
  - SCONOx and Catalytica costs
  - typical lifetime vs vendor guarantee
- Lean Pre-Mix (LPM)
- Missing Information

MISSING INFORMATION

- Documentation for 8,000 turbines estimate
- Ductwork costs*
- Increased fuel use due to catalyst*
- Incremental O&M costs
- Catalyst disposal costs/catalyst recovery credit
- Cost differential for “dirty” fuel
- Duct burners
- Retrofit Costs
  - demolition costs
  - space constraints
  - HRSG

*Sam Allen has provided information on these costs

ESTIMATE EMISSION REDUCTION

- Use AP-42 emission factors developed from emissions database
  - use sum of average, individual HAP emission factors to estimate total HAP emissions (lb/MMBtu)?
  - do not use “high” formaldehyde and low load GRI data
- Value for % emission reduction?
- Value for turbine efficiency (used with MW capacity to calculate MMBtu/hr input)

Extrapolate Model Plant Costs and Emission Reductions to National Basis

- EAWG needs cost/emission reduction estimates on an SIC basis
- Extrapolate costs/emission reductions for model plants using distributions from inventory database
  - capacity, operating hours
- Database gaps exist for cost-related parameters
  - space constraints
  - HRSG units
- Example extrapolation

EXAMPLE EXTRAPOLATION APPROACH

SIC 4911 ; 1515 turbines; 37.5% of total database population

Model Plant Info			Exhaust		Emission	Database Distributions				
Plant	Capacity	Op. Hrs.	Flow	TAC	Reduction	Capacity	Cap.	Op. Hr.	Hrs.	No.
No.	(MW)	(hrs/yr)	(lb/sec)	($/yr)	(Mg/yr)	Category	%	Ranges	%	Turbines
1	85.4	8000	658			L1	15.9	1-499	36.1	87
1								500-6999	22.2	53
1								7000-8760	41.7	100
1										
1A										
etc.										

No. Turbines = 1515 * 0.159 * 0.361 = 87

Emission Reduction (lb/yr) = MW/(turbine eff.) * [(MMBtu/hr)/MW] * (hr/yr) * (E.F., lb/MMBtu) * (control eff/100)

MODEL TURBINE PARAMETERS

Turbine Parameter	Population Database
• Fuel Type	• Fuel Type
• Unit Size	• Capacity, Make/Model
• Operating Hours/Year	• Hours of Operation
• Heat Recovery (Y/N)	• Not Available
• Typical Applications	• SIC/SCC
• Location (Space Constrained?)	• No space constraint info in database

Population of Key Parameters

- Total number of turbines in Version 3 = 4,832

- Population of key parameters:
  - Fuel Type = 100%
  - Capacity = 59%
  - Hours of Operation = 83%
  - SIC Code (single only) = 84%

FUEL TYPE DISTRIBUTION (100% Populated)

Fuel Type	Percent of total populated
Natural Gas	54.3
Distillate Oil	24.5
Dual Fuel	14.5
Kerosene/Naphtha (Jet Fuel)	5.6
Landfill Gas	0.5
Other*	0.6

- *Other includes crude oil, process gas, petroleum refining gas, propane, digester gas, gasoline, fuel oil, liquified petroleum, and fuel unspecified

CAPACITY DISTRIBUTION
(59% Populated)

• Size	Capacity Range (MW)	Percent
	<0.08	2.0
S1	0.08 - 2.29	33.3
S2	2.30 - 6.29	18.8
S3	6.30 - 17.9	11.1
M1	18.0 - 33.2	5.0
M2	33.3 - 62.4	12.1
L1	62.5 - 127.6	9.7
L2	127.7 - 400.0	6.5
	>400.0	1.5

HOURS OF OPERATION

(87% of turbines with capacity information have hours of operation populated)

Range	SMALL	MEDIUM	LARGE
0	2.0	2.2	----
1 - 499	19.9	46.4	36.1
500 - 999	3.4	5.4	3.7
1000 - 3999	11.3	7.0	8.9
4000 - 6999	8.0	4.0	9.6
7000 - 8760	55.4	35.0	41.7

SIC DISTRIBUTION

(82% of turbines with capacity information have single SIC codes)

SIC	% SMALL			%MEDIUM		%LARGE	
	S1	**S2**	**S3**	**M1**	**M2**	**L1**	**L2**
49**	**22**	**17**	**12**	**5**	**19**	**16**	**9**
13**	**48**	**30**	**13**	**6**	**1**	**1**	**1**
97**	**91**	**2**	**6**	**1**	**---**	**---**	**---**

49 Electric, Gas, and Sanitary Services = 63.1% of total populated**

13 Oil and Gas Extraction = 14.1% of total populated**

97 National Security and International Affairs = 3.7% of total pop.**

Consensus Items/Data Needs

- CTWG consensus on national impacts approach
- Assignments for gathering data still needed

ATTACHMENT VI

PRESENTATION BY GRI ON COST EFFECTIVENSS OF OXIDATION CATALYSTS ON GAS TURBINES

Oxidation Catalyst Cost Effectiveness for Control of HAPs from Gas Turbines

Preliminary GRI Study Based on:

- **Catalyst Cost Quote from 2 Vendors**
  - **Quote for "High/Med/Low" CO Reduction Efficiency**
  - **Estimate VOC Control for Application**
- **Assume Catalyst Reduction Efficiency for H_2CO Same as for VOC**
  - **Vendor/Other Data Sources for H_2CO Sparse**
- **Follow OAQPS Cost Manual and Gas Turbine Alternative Control Techniques Document**
- **Example Turbine: Gas Compression Application**
  - **"Typical" from Limited GRI Tests**
    - **6000 hp; 0.7 ppmv HAP; 980 ^oF Exhaust Temp**

Cost Summary: Turbine Oxidation Catalyst

Control Level	CO Control Efficiency (% Removal)	Estimated HAP Control (% Removal)	Total Annualized Costs ($/hp yr)	HAP Cost Effectiveness ($/ton)
High	98	50, 95	42 - 46	120,000 - 250,000
Medium	90 - 98	35, 55	20 - 37	101,000 - 288,000
Low	75 - 90	22, 35	17 - 32	135,000 - 400,000

- $3700 - $9800/ton for CO
- $76,000 - $300,000/ton for VOC

Summary

- **Even at High % Reduction, $/ton is High**
- **Considerable Difference in Capital Cost Quotes Between Two Vendors**
- **Reasonable Capital Cost Ground Truthing from Industry Installation**
- **Cost Spreadsheets Included in Appendix**
- **Report Number GRI-98/0218**
  - **Final Report Available Approximately 8/15/98**
    - **Call 512-419-5719 to Request**
  - **Can Work With Interested Parties in Interim!**

Outstanding Issues...

- **PRELIMINARY STUDY**
  - **Verification of Assumptions Regarding Control Efficiency, Detailed Costs Estimates, etc. Needed if Catalysts Continue to be Considered**
- **Additional Sensitivity Analyses**
- **Questions on Catalysts for T >1200 ^{o}F**
- **If Catalysts Still of Interest, Compare Emissions Benefit to Lifecycle Impacts for Manufacturing, Installation, Disposal**